



The effect of precipitation over the macroinvertebrate abundance of two streams in San Juan, Puerto Rico

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INTRODUCTION

Puerto Rico, a tropical island laying between the Atlantic Ocean and the Caribbean Sea has a climate classified as tropical marine. Climate is defined as the average of all weather conditions in an area over a long period of time [1], mostly based on the amount of temperature and precipitation registered. Furthermore, characteristics of a tropical marine climate include minuscule season changes and the movement of air masses over and around the island; hence winds are one of the most important factors that influence the climate in Puerto Rico. In addition, due to the winds' direction and location, an annual pluvial season occurs beginning at June 1 and ending in November 30 [1]. This leads to the formation of thunderstorms and hurricanes, which are tropical cyclones with violent winds, heavy rains, and floods [3]. Great quantities of rainfall may overload the capacity of the riverbanks and result in dangerous floods. The effects of these disturbances are correlated to the intensity and frequency of rain in the surrounding areas [4]. The amount of precipitation may also affect streams due to the fact that it is able to alter the transfer sediments between locations; these soil particles and rock materials carried by the stream's flow are called stream load. Depending on the amount of pressure enforced by the water in the river, sediments are translated: large, heavy sediments are pushed or rolled downstream whereas, lighter sediments are picked up and carried along with the water [1]. In this research, benthic samples were collected with a baseline of small quantities of rain for several weeks prior to collection. Three additional samples were collected: after a passing storm, and then in two to four week intervals for the last two. Results demonstrated that the amount of precipitation over Puerto Rico, which commonly results in floods, may affect the abundance of macroinvertebrates. This is mostly due to the influence that the strong currents exert on both the macroinvertebrate habitats and the organisms themselves.

HYPOTHESIS

Macroinvertebrate abundance in the urban stream will be more affected by the amount of precipitation compared to the rural stream. Macroinvertebrate abundance will be influenced by the impact of floods in their habitat, and their quantity will reflect the influence of precipitation upon the stream.

MATERIAL AND METHOD

Two streams were chosen, one in a rural area (Rivera Stream) and one in an urban area (El Señorial Stream). The experiment was done during a period of four months, from September 2012 through December 2012. The first sample was taken with a baseline of at least two weeks without excessive rain, the second sample was posterior to a rainstorm and the third and fourth sample were taken in intervals of 2 to 4 weeks. Each visit consisted of water quality samplings, pH level and temperature measurements, macroinvertebrate sampling, along with a water quality assessment data sheet, data form for calculating flow, a benthic macroinvertebrate habitat data sheet and, in the first visit, a stream site general assessment. All samples were taken facing upstream.

Water quality samples consisted of filling three replicates of Total Suspended Solids (TSS), three replicates of Total Phosphorus (TP), and a single replicate of Blank Water. Besides the water quality samples, air and water temperature, as well as PH levels, were measured with a Milwaukee® pH52 pH/temperature meter.

With the purpose of measuring and recording the temperature of the streams, a Thermochron® iButton® was installed inside a capsule submerge close to a riffle on the stream. The iButton® was programmed to sample every 60 minutes and every month the iButton® was replaced with another one. In order to download the data at the computer, the iButton® was plugged in to the computer through a USB Adapter, where all the information appeared in the 1-Wire API and posteriorly sent to Saint Michael's College.

Macroinvertebrate samplings were conducted during every visit on six different riffles, to obtain a total 48 samples taken at the end of investigation. The samples were done moving upwards starting downstream, followed by a disturbance of each riffle for a period of sixty seconds while holding a kick net in front to capture all organisms that detached when the rocks were disturbed. The samples were then preserved in Whirl-pak® bags with 95% ethanol.

Following sample collection, water quality samples were sent to Saint Michael's College for their analysis. In addition, a total of thirty vials with macroinvertebrates were sent to the laboratory at the college for further examination. The remaining sixteen vials were quantified and identified with the "Guide to Aquatic Invertebrates of the Upper Midwest".

CONCLUSION

The results obtained through the analysis of the streams support the hypothesis that the macroinvertebrate abundance would be influenced by the impact of floods in their habitat. The data showed that the macroinvertebrate abundance was inversely proportional to the amount of precipitation. During the months with more precipitation, the abundance was minimum, while during the months with little precipitation, the abundance increased. It could also be observed that the urban stream (PN_SenStrm_49) had a greater amount of macroinvertebrates compared to the rural stream (PN_RivStrm_154). The abundance of macroinvertebrates reflected the influence of precipitation upon the streams.

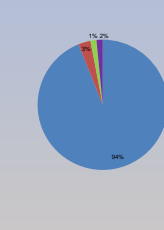
ACKNOWLEDGEMENTS

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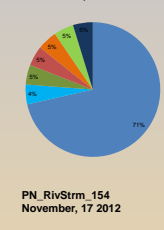
RESULTS

The data demonstrated that the macroinvertebrate abundance was higher during the months that didn't have any drastic impact of precipitation compared to the months that did have. Throughout the months of September, November and December, there was very few precipitation, which means that both streams didn't suffer from any harsh changes. On the other hand, on October there was the Storm Rafael and Hurricane Sandy. Both weather events caused several floods and impacts on both streams. Due to those weathers, during the months of September, November, and December the macroinvertebrate abundance was higher compared to the abundance on October.

PN_RivStrm_154
September 15, 2012



PN_RivStrm_154
October 20, 2012



PN_RivStrm_154
November 17, 2012

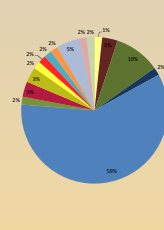
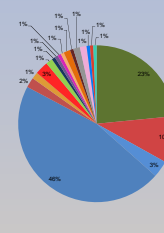
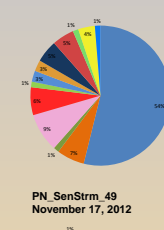


Figure 1: Abundance of the macroinvertebrates in each sample date at the Rivera Stream (PN_RivStrm_154).

PN_SenStrm_49
September 15, 2012



PN_SenStrm_49
October 20, 2012



PN_SenStrm_49
November 17, 2012

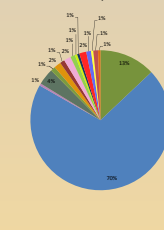


Figure 2: Abundance of the macroinvertebrates in each sample date at the El Señorial Stream (PN_SenStrm_49).

Week (2012)	Average weather description	Sample date	Additional Observations
August 26-September 1	Partly shaded		September 1: Storm Leslie
September 2-8	Partly shaded		
September 9-15	Partly shaded	September 15	
September 16-22	Partly shaded/ Scattered clouds		
September 23-29	Partly shaded/ Scattered clouds/ thunders		
September 30-October 6	Partly shaded/ Scattered clouds/ Thunders		
September 7-13	Thunders	October 12: Storm Raphael	
October 14-20	Thunders	October 20	
October 21-27	Partly shaded/ Scattered clouds		October 27: Hurricane Sandy
October 28-November 3	Partly shaded/ Scattered clouds		
November 4-10	Partly shaded/ Scattered clouds		
November 11-17	Partly shaded/ Scattered clouds	November 17	
November 18-24	Partly shaded/ Scattered clouds		
November 25- December 1	Partly shaded/ Scattered clouds		
December 2-8	Partly shaded/ Scattered clouds	December 2	

Table 1: The period of investigation was from August to December 2012. Daily weather observation and before and after Hurricane Sandy samples, were taken.

PN_RivStrm_154

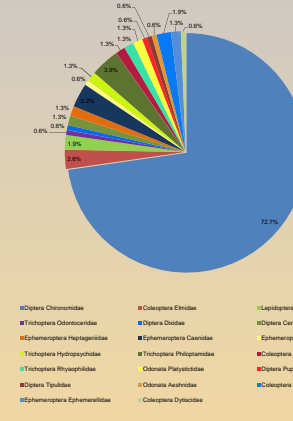


Figure 3: Rivera stream macroinvertebrate average abundance of the second semester of 2012.

PN_SenStrm_49

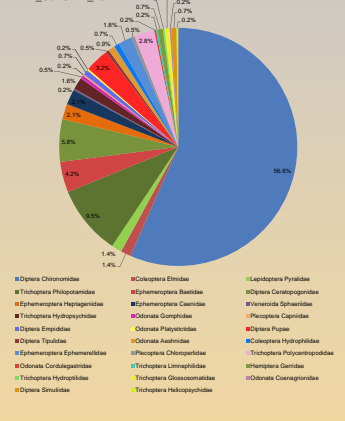


Figure 4: El Señorial stream macroinvertebrate average abundance of the second semester of 2012.

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